

RESEARCH PAPER

A synopsis of Nimmo's *Croton* (Euphorbiaceae: Crotoneae) including an overlooked new species from India

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Abstract

Graham's posthumous publication (Cat. Pl. Bombay, 1839) was completed by Joseph Nimmo, in addition to contributing several new species in it. *Croton gibsonianus* Nimmo and *C. lawianus* Nimmo (Euphorbiaceae) were part of this addition, and both were described based on Gibson's collection from adjoining localities in the Western India. As the diagnosis of the latter species was scant, it was subsequently interpreted in different genera viz. *Dimorphocalyx*, *Trigonostemon* and *Tritaxis*. Due to misinterpretation of the protologue and Gibson's *Croton* collection housed at K, the name *C. lawianus* was wrongly applied to *C. gibsonianus* by subsequent authors. This inadvertent application of name is corrected here and referred to the hitherto undescribed new species *C. chakrabartyi*. Our recent collection of *C. gibsonianus* has turned out to be a rediscovery after 170 years. The nomenclature, description, photographs, and distribution of *C. gibsonianus* are provided to avoid further taxonomic ambiguity.

KEYWORDS

Taxonomy, *Croton gibsonianus*, rediscovery, endemic, Western Ghats

1 | INTRODUCTION

The genus *Croton* L. is distributed throughout tropical and subtropical regions of the world with ca. 1160 species (Balakrishnan & Chakrabarty, 2007; POWO, 2020). It is the second largest genus in the family Euphorbiaceae, and most species are Neotropical (Caruzo & Cordeiro, 2013). In India, *Croton* consists of 16 taxa, of which four species namely *C. gibsonianus* Nimmo, *C. lawianus* Nimmo, *C. malabaricus* Bedd., and *C. scabiosus* Bedd. are endemic. *C. bonplandianus* Baill. and *C. glandulosus* L. are introduced taxa, now naturalized, and often occur as weeds (Balakrishnan & Chakrabarty, 2007; Nayar et al., 2014; Singh et al., 2015). *Croton* can be distinguished from its allied *Paracroton* by its non-appendaged calyx lobes, female flowers devoid of petals, and buds with apically inflexed staminal filaments (Balakrishnan & Chakrabarty, 2007).

Ongoing taxonomic work of the current investigators on the endemic flora of northern Western Ghats has resulted in collection of an interesting *Croton* species. Critical scrutiny with respect to its identity and nomenclature led to the conclusion that many *Croton* species described originally from this region need further careful attention.

2 | MATERIALS AND METHODS

Relevant literature with respect to current work were accessed through JSTOR and BHL. Binomials, their synonymy, and references were procured from online plant databases such as POWO, Tropicos. Plant name authors and collector details were obtained from Taxonomic Literature II and IPNI. For plant description and terminology Chakrabarty & Balakrishnan (1997) and Beentje (2016) were followed. Descriptions were

based on field observations, herbarium specimens, and photographs. Personal visits to BLAT, BM, BSI, CAL, DD, and K were made to consult the *Croton* collection by Dalzell, Gibson, Stocks, Law, and other regional floristic workers (cited in specimen examined). The collection at A, HIFP and JCB were consulted online. Field visits were conducted to the type localities of *C. gibsonianus* and *C. lawianus*. The collected plant material was processed, and voucher specimens are deposited at BSI, CAL and NGCPR. The digitized version of the specimens at NGCPR are available through herbarium webpage: <http://ngcpr.org/herbariumCatalogue.aspx>. Distribution data is generated from field visits and available specimens. Distribution map was produced in DIVA-GIS 7.5 application.

Nimmo's *Croton gibsonianus* and *C. lawianus*:

After the death of John Graham in 1839, Joseph Nimmo completed Graham's 'A Catalogue of the Plants Growing in Bombay and its vicinity' and added to it more than 80 species, including few novelties at the end of the publication as an addendum. *Croton gibsonianus* and *C. lawianus* (Graham, 1839: 251) are part of the same addition, based on Gibson's collections from adjoining hilltops of Western India viz. Hurreechunderghur (Harishchandragad) and Bheema Sunker (Bhimashankar) respectively. Both the species were validly published, but the latter was more briefly defined (like most taxa in Graham's Catalogue) and remained in taxonomic and nomenclatural ambiguity as the original material was uncertain. Yet another species *C. gibsonii* J. Graham, which appeared in the main text of the 'Graham's Catalogue' is also often confused with Nimmo's *C. gibsonianus* due to similarity in specific epithet (Müller, 1866), the former is now part of the genus *Acalypha* (Almeida, 2003).

Croton gibsonianus was described by Nimmo as "A tree 15 ft high, leaves bifarious, oval-acuminate, nectaries five, orange coloured with cordate glands, stamens about 15, capsule red when ripe, size of a walnut. Female flowers not yet seen". The original material cited by Nimmo as 'Dr. Gibson, Harishchandragad' is untraceable. Nevertheless, the collection housed at K (Dalzell s.n., K000246855) and an illustration (Figure 1, Noltie, 2002) at E, both annotated as '*C. gibsonianus*' in Dalzell's handwriting agree with the Nimmo's interpretation (except capsule) of *C. gibsonianus*.

Dalzell & Gibson (1861) in 'Bombay Flora' seem to have extracted few phrases from Nimmo's diagnosis and added few characters such as "lateral spike, male flowers below the female, (capsule) size of the cherry" and cited localities as Harishchandragad and hills of Alun and Koorun near Nashik. These amended characters by Dalzell seem to be incorrect and contradictory to his collection and illustration.

Hooker (1887) erred in treating Gibson's collection housed at K (*Croton* no. 20: K000246847, with pencil annotation as '*gibsonianus*' by Hooker) as *C.*



FIGURE 1 Illustration of *Croton gibsonianus* reproduced from - The Dapuri drawing by H. Noltie (2002)

gibsonianus and amending the description as "a shrub, leaves elliptic-oblong, stamens 10, capsule ca. 1.3 cm in diameter ...". These characters conflict with the protologue which attributes characters such as: a tree, leaves oval-acuminate, stamens 15, capsule walnut sized (Table 1). It clearly indicates that Hooker labelled an altogether different plant as *C. gibsonianus*.

Talbot (1894) followed Hooker's portrayal and labelled his collections from North Canara, Gersoppa falls as *C. gibsonianus*, yet commented on the discrepancies between his collections and description of *C. gibsonianus* provided by Nimmo. His plants from Canara were differing from protologue by having small shrubby habit, elliptic, acute, or shortly acuminate leaves, non-cordate glands, 10-stamens, small capsule with grey tomentum at maturity. Although, Talbot was correct in distinguishing *C. gibsonianus* and his plants from Canara (Talbot 827, Talbot 1095 at CAL), no taxonomic decision was made by him nor by subsequent floristic workers (Woodrow, 1899; Cooke, 1906; Brandis, 1906; Rama Rao, 1914; Gamble, 1925; Vajravelu & Ramchandran, 1986).

Chakrabarty & Balakrishnan (1997) in their revision of Indian *Croton* and their subsequent treatment of Euphorbiaceae (Balakrishnan & Chakrabarty, 2007)

TABLE 1 Comparative morphology of *C. gibsonianus* Nimmo and *C. chakrabartyi* Dhabak & Nandikar

Characters	<i>C. gibsonianus</i>	<i>C. chakrabartyi</i>
Habit	a tree, up to 6 m high	a shrub, up to 2 m high
Leaf		
phyllotaxy	alternate, bifarious	alternate-spiral to subopposite
shape	ovate	elliptic-oblong
margin	entire, ciliate	serrate, glandular at tip
venation	actinodromous	penninerved
Inflorescence	ca. 5 cm in length	10–30 cm in length
Stamens	15–21	9–12
Male flower Nectaries	cordate	oblate
Sepal in female flowers	ovate-elliptic, 4 – 10 × 3 – 5 mm, accrescent in capsule	ovate, ca. 2.5 × 1 mm, not accrescent in capsule
Ovary	ovoid, ca. 3 × 3 mm, sparsely stellate hairy	globose, ca. 2 mm in diameter, densely stellate hairy
Capsule	green-yellow, ovoid to sub globose, 14 – 18 × 15 – 17 mm, glabrous to sparsely stellate hairy	greyish brown, globose, 9 – 14 mm in diameter, densely stellate hairy

followed Hooker's interpretation and keyed out *C. gibsonianus* based on penninerved, oblong-elliptic, serrate leaves, and elongated racemes. They cited all the collections from Karnataka under *C. gibsonianus* and indicated Gibson's collection at K (referred by Hooker, barcode K000246847) as "holotype". There is no evidence that Nimmo used this specimen when *C. gibsonianus* was described, rather it is contradictory with the protologue characters, and therefore has no consequence as original material. Their description, illustration, and listed specimens *per se* do not agree with the protologue of *C. gibsonianus* and evidently indicate a hitherto undescribed species which is named here as *C. chakrabartyi*.

Rediscovery of *Croton gibsonianus*:

Croton gibsonianus is apparently endemic to the northern Western Ghats of Maharashtra. It was previously known by four collections at CAL and K by Law (*Croton* no. 19, barcode K00024854), Gibson (*Croton* no. 19, barcode K000246856; *Croton s.n.*, barcode CAL0000033599), and Dalzell (barcode K000246855) from Bombay presidency and is now rediscovered here from the type locality after a gap of around 170 years. As the original material of *C. gibsonianus* is missing and seemingly not extant, the present collection is therefore designated here as neotype (Art. 9.13 of ICN, Turland et al., 2018) for nomenclatural stability.

Ambiguous status of *Croton lawianus*:

The next *Croton* in the addendum by Nimmo was *C. lawianus* (Graham, 1839). He described it as "Seeds as in *Croton*, capsule girded by a 3-leaved involucre. Leaves oblong lanceolate, entire. A large tree. Bheema Sunker. Dr. Gibson". The diagnosis is inadequate to determine the identity of this taxon and whether it falls within the circumscription of *Croton* or not; moreover, possibly there is no original material extant. Hooker (1887) had wrongly included the collections of Law,

Gibson and Dalzell under *C. lawianus* as explained in detail above and is now recognised here as *C. gibsonianus*. Despite a very scant diagnosis, *C. lawianus* was later interpreted as *Dimorphocalyx* Thwaites (1861: doubtfully included in synonymy of *D. glabellus* Thwaites), *Trigonostemon* Blume (Müller, 1865: as *T. lawianus*), and *Tritaxis* Baillon (Yu, et al., 2019: as *T. glabella* var. *lawiana*).

Almeida (2003) identified *Croton lawianus* as conspecific with *C. ramiflorus* J. Graham, without detailing the factual basis of this taxonomic treatment. *Croton ramiflorus* was published in the main text of Graham's Catalogue, with diagnostic characters being "flowers small, white; grow from the naked branches, and capsule half hid in the calyx of 5-scarious wings", the description unequivocally follows the circumscription of *Dimorphocalyx*. Seemingly this is the reason that Almeida (2003) validly published it as *Dimorphocalyx ramiflorus* (J. Graham) M.R. Almeida and relegated doubtful *C. lawianus* into it. Nevertheless, Chakrabarty & Krishna (2020) retained *C. lawianus* as a distinct species of *Croton*. It is evident that the taxonomy and nomenclature of *Dimorphocalyx ramiflorus*, *D. lawianus* Hook.f. and *D. glabellus* Thwaites (now part of core *Tritaxis*, Yu, et al., 2019) is debatable (Beddome, 1866; Hooker, 1887; Santapau, 1953; Chakrabarty & Balakrishnan, 2007) and requires detailed attention. As names published in Graham's Catalogue have priority over all the later published names (Art. 11.3 of ICN, Turland et al., 2018), they may undergo substantial nomenclatural changes in near future.

Taxonomy:

Croton gibsonianus Nimmo in Addenda, J. Graham, Cat. Pl. Bombay 251. 1839, *descr. hic amplif.* Figure 2

Type: Hurreechuderghur, Gibson *s.n.* (possibly not extant). Neotype (designated here): India, Maharashtra, Harishchandragad, 12.12.2020, M. Dhabak & R.B. Chaudhari 002098 (CAL); isoneotypes (BSI, NGCPR).

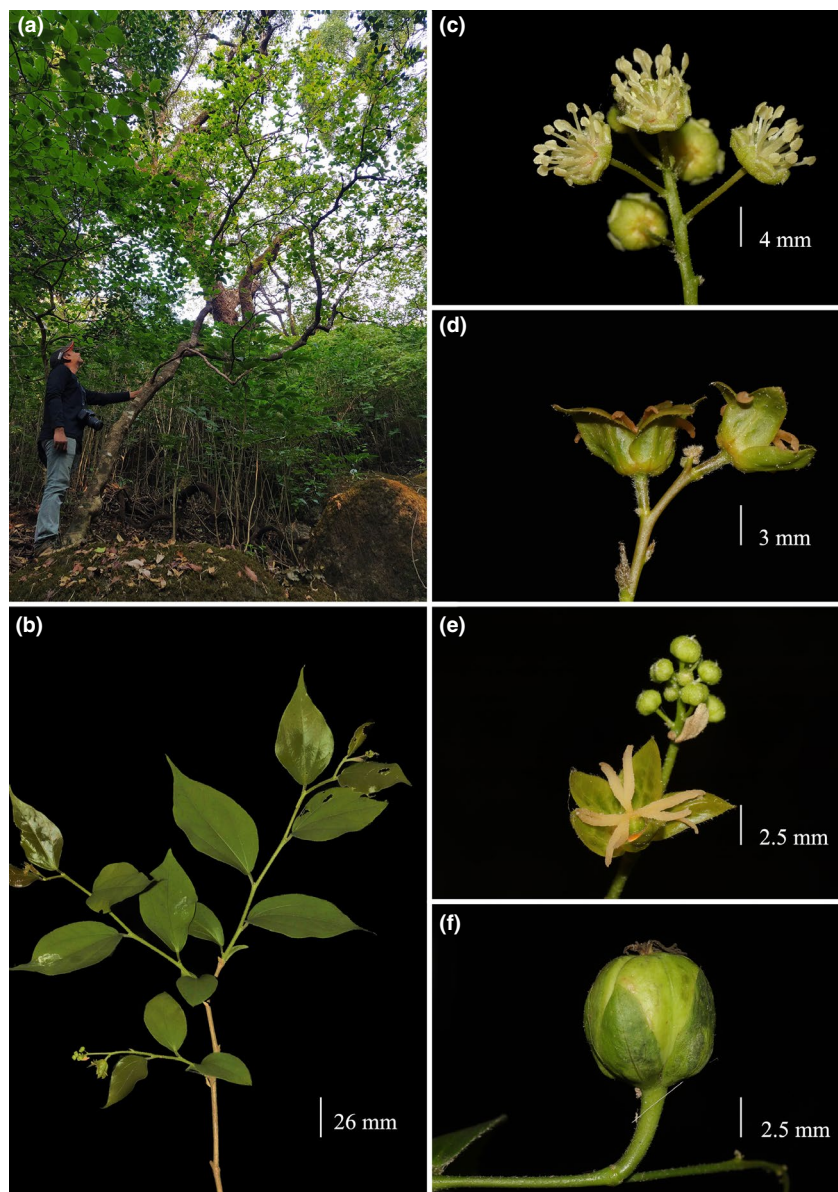


FIGURE 2 *Croton gibsonianus* - (a) Habit, (b) Flowering twig, (c) Male flowers, (d) Female flowers (lateral view), (e) Female flower (top view), (f) Capsule. Photographs: Maniruddin Dhabak

Croton lawianus auct. plur. non Nimmo, 1839: Hooker, Fl. Brit. India, 5: 394. 1887; Talbot, Syst. List Trees Bombay, ed. 1: 184. 1894 & Forest Fl. Bombay, 2: 472. 1911 (*in obs.*); Cooke, Fl. Bombay, 2: 601. 1906 (*in obs.*); Brandis, Indian Trees, 578. 1906; Gamble, Fl. Madras, 1315. 1925; Chakrabarty & Balakrishnan, Bull. Bot. Surv. India, 34: 57. 1992 [publ. 1997]; Saldanha, Fl. Karnataka, 2: 128. 1996; Balakrishnan & Chakrabarty, Fam. Euphorbiaceae India, 214. 2007.

Monoecious trees, up to 6 m high; branchlets terete, covered with stellate hairs, with translucent exudate. Leaves simple, alternate, distichous, petiole 4 – 8 mm long, densely stellate hairy, lamina ovate, 4.5 – 10(–14) × 2.5 – 5(–7) cm, apex acuminate to caudate, margin entire, ciliate, base usually cuneate to rounded, with two lateral, elliptic, ridged glands, characteristically

tri-nerved (actinodromous) at the base, adaxial surface glabrous, abaxial surface densely stellate pubescent (especially the veins). Flowers in terminal and axillary racemiform cymes (ca. 5 cm long), sparsely stellate hairy, bracts lanceolate, ca. 3 mm long, abaxially pubescent, often caducous. Male flowers: pedicel ca. 8 mm long, stellate-pubescent, bracteole inconspicuous; sepals 5, imbricate, equal, ovate, ca. 3 × 2 – 2.5 mm, acute, abaxial surface stellate hairy, glabrous adaxially, faintly 1 – 2-veined; petals 5, membranous, cream to yellowish, obovate, ca. 4 × 3 mm, reflexed, glabrous outside, villous inside (at base in particular); stamens inflexed at the apex in buds, 15 – 21 in two whorls, outer whorl antepetalous, filament glabrous, ca. 2 mm long, anthers basifixed, dithecal, oblong, ca. 1 × 0.6 mm; glands 5, conspicuous, cordate, ca. 1 ×

1 mm, orange-red. Female flowers: pedicel 2 – 5 mm long, stellate hairy; bracteole as in male flower; sepals 5, equal (accrescent with capsule), ovate-elliptic, 4 – 10 × 3 – 5 mm, apex acute, often emarginate, abaxial surface sparsely stellate pubescent, adaxial surface glabrous, margin ciliate, faintly reticulate; petals rudimentary (inconspicuous or linear); gland oblate, ca. 1 × 1.8 mm, otherwise similar to the male flowers; ovary ovoid, ca. 3 × 3 mm, sparsely stellate hairy; styles 3, linear, ca. 5 mm long, bifid twice, apricot to peach colored, stigma simple. Capsule greenish yellow (red as per in the protologue), trilocular, ovoid to subglobose, 14 – 18 × 15 – 17 mm, glabrous to sparsely stellate-pubescent, coriaceous, girded with conspicuous accrescent sepals, ca. 16 × 7 – 8 mm; seeds 3, 1 per locule, ellipsoid, 8 – 13 × 5 – 7 mm, mature seed stramineous, mottled with vinaceous-purple, strophiolate.

Distribution & Ecology: The plants grow in shady undergrowth of semi-evergreen forest along the water streams. The species is apparently endemic to northern Western Ghats of Maharashtra, India and grows in association with *Strobilanthes callosus* Wall. ex Nees and *Actinodaphne* sp.

Phenology: December to February.

Conservation Status: The species was earlier assessed as Critically Endangered (CR B1 + 2c) based on the Baba Budan hills (Karnataka) subpopulation (World Conservation Monitoring Centre, 1998: as '*Croton lawianus*'). As discussed above the occurrence of the species in Baba Budan hill is uncertain. Currently, the only extant population of this taxon is known from the type locality Harishchandragad in Maharashtra within northern Western Ghats. The location is threatened due to habitat degradation because of increasing tourism activities and related land encroachments. In addition to habitat conservation, ex-situ conservation actions are urgently needed. Based on this locality the Area of Occupancy (AOO) is calculated as 4 km². Around 50 mature individuals are observed with some seedlings. Thus, based on the restricted AOO, less than 50 mature individuals and observed continuing decline in the quality of habitat the species is assessed here as Critically Endangered (CR) 'B2ab(iii); C2a(i,ii); D' following IUCN Redlist Guideline version 14 (2019).

Specimens examined: INDIA: Bombay, s.d., *Gibson* 19, (K barcode K000246856!); s.loc., s.d., *Gibson* s.n., (CAL barcode CAL0000033599 image!); Bombay, s.d., *Dalzell* s.n. (CAL barcode CAL0000033600 (fide Chakrabarty & Krishna, 2020); *ibid.*, *Dalzell* s.n., (K barcode K000246855!); *ibid.*, *Dalzell* s.n., (K!); Concan (Konkan), s.d., *Law* 19., (K barcode K000246854!).

Note: A collection attributed to Law at K (*Croton* no. 19, barcode K000246854) has two labels indicating 'Concan and Bababoodan hills'. It is unclear that whether the labels were written by Law himself, or it has been misplaced with Concan collections. Moreover, occurrence of *Croton gibsonianus* at Baba Budan hills

appears to be very disjunct in comparison with type locality (Harishchandragad). Hence, targeted fieldwork at Baba Budan hills is needed to settle these doubts.

Collection of Gibson from Bombay (*Croton* no. 19, barcode K000246856) and duplicate at A (barcode A00048912) with fragmented leaves also belong to *C. gibsonianus*. Similarly, another Gibson's collection housed at CAL (barcode CAL0000033599) with damaged label, inadvertently designated as lectotype of *C. lawianus* by Chakrabarty & Balakrishnan (1997) also belong to *C. gibsonianus*.

Croton chakrabartyi Dhabak & Nandikar sp. nov.
Figure 3

Type: India, Karnataka, Uttara Kannada, Sirsi to Kumta Road, 17.01.2021, *M.D. Nandikar, M.M. Sardesai, G. Hegde* 002099 (holotype CAL; isotypes BSI, NGCPR)

Diagnosis: The species is morphologically similar to *Croton klotzschianus* (Wight) Thwaites but differs in having oblong-obovate, acuminate (vs ovate-elliptic, acute) leaves; stipitate (vs sessile) foliar glands; absence (vs presence) of stomata on adaxial surface of leaves; longer (vs shorter) inflorescence axis; larger [10–14 mm (vs 6–10 mm) in diameter] capsules.

Croton gibsonianus auct. plur. non Nimmo, 1839: Hooker, Fl. Brit. India, 5: 392. 1887; Talbot, Syst. List Trees Bombay, 184, 1894; Cooke, Fl. Bombay, 2: 600. 1906; Nairne, Fl. Pl. W. India, 295. 1894; Brandis, Indian Trees, 578. 1906; Chakrabarty & Balakrishnan, Bull. Bot. Surv. India, Vol 34: 46. 1992 [publ. 1997]; Saldanha, Fl. Karnataka, 2: 127. 1996; Almeida, Fl. Maharashtra, 4B: 300. 2003; Balakrishnan & Chakrabarty, Fam. Euphorbiaceae India, 213. 2007.

Monoecious shrubs, up to 2 m high; branchlets angular (pentagonal), stellate-pubescent, with translucent exudate. Leaves simple, alternate, spirally arranged, rarely subopposite, stipulate, stipule subulate, 2 – 2.5 mm long, petiole 0.5 – 4.5 cm long, channeled above, lamina elliptic-oblong, (5–) 7 – 25 × (1–) 2 – 7 (–10) cm, apex acuminate to caudate, margin distantly serrate in mature leaves and closely serrate in young leaves, serration glandular at tip, base cuneate to rounded with two ridged stipitate basal glands, venation penninerved, lateral nerves 4 – 14 pairs, glabrous on both sides (young leaves sparsely stellate pubescent). Flowers in terminal racemiform cymes of (10 –) 17 – 30 cm in length, rachis glabrous to sparsely stellate-pubescent. Male flowers: often 1 – 3 per node, pedicel 3 – 8 mm long, stellate-pubescent; receptacle woolly; sepals 5, ovate-elliptic to oblong, 1.5 – 2.5 × 1 – 1.5 mm, acute, glabrous to sparsely pubescent outside; petals 5, recurved, spatulate to oblanceolate or oblong with obtuse apex, margin ciliate, woolly at the base on adaxial side ca. 1 × 0.5 mm, pilose; stamens 9 – 11 (–12), filaments ca. 1.5 mm long, anthers oblong, ca. 0.5 mm long, glands 5, oblate. Female flowers: solitary to few, at the proximal end of the raceme; pedicel

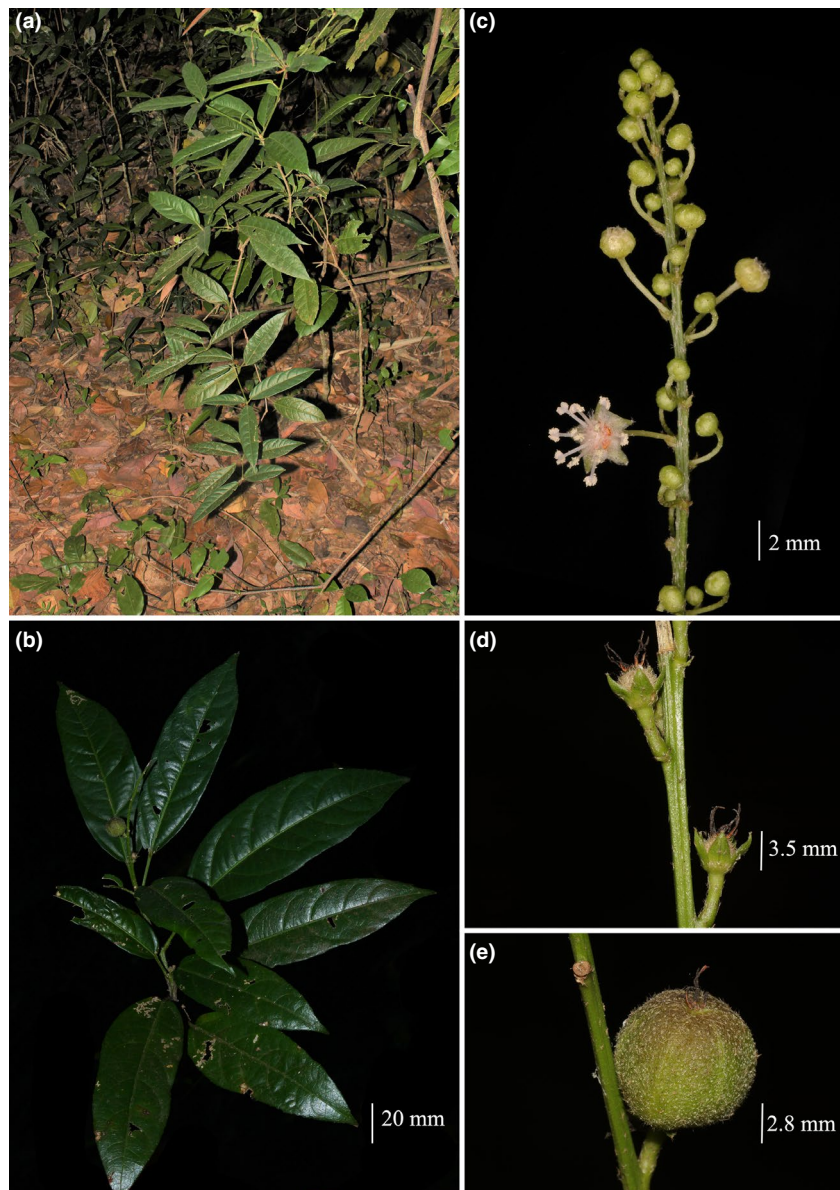


FIGURE 3 *Croton chakrabartyi* - (a) Habit, (b) Branch, (c) Male flowers, (d) Female flowers, (e) Capsule. Photographs: Mayur Nandikar & Navendu Page (C)

2 – 5 mm long, stellate hairy; bracteolate, bracteole ca. 1 mm long; sepals 5, ovate, ca. 2.5×1 mm, sparsely stellate hairy abaxially; petals 5, much reduced to tufts of hairs; nectaries 5, oblate; ovary globose, ca. 2 mm in diameter, densely stellate hairy; styles 3, free or shortly connate at base into a column, linear, 2.5 – 4.5 (–8) mm long, bifid, abaxially glabrous to stellate hairy, stigma simple. Capsule greyish brown, globose, 9 – 14 mm in diameter, tricoccus, without accrescent sepals, densely stellate pubescent; seeds 1 per locule, mature seeds oblong to ellipsoid, 5 – 9 $\times$ 3 – 8 mm, grey, brown to black mottled, strophiolate.

Distribution & Ecology: The species is endemic to Karnataka and Kerala (*vide* Balakrishnan & Chakrabarty, 2007; Sankar et al., 2007) in southern Western Ghats, India (Figure 4). It grows in evergreen

forest as undergrowth or along the forest margin and perennial streams; in association with other endemics viz. *Gymnostachyum warrierianum* K.M.P. Kumar, Balach. & V.B. Sreek. and *Strobilanthes ciliata* Nees.

Phenology: September to March.

Etymology: The specific epithet honors Dr. Tapas Chakrabarty (ex-scientist, Botanical Survey of India) for his contribution in the taxonomic studies on Indian *Croton*.

Conservation Status: The species is locally common in the evergreen forest of Karnataka and is also reported from Kerala. No ongoing major threats are known for the species. Besides this, some subpopulations occur at the protected Agumbe reserve forest and Anappady Medicinal Plants Conservation Area (MPCA). Thus, the species assessed here as Least

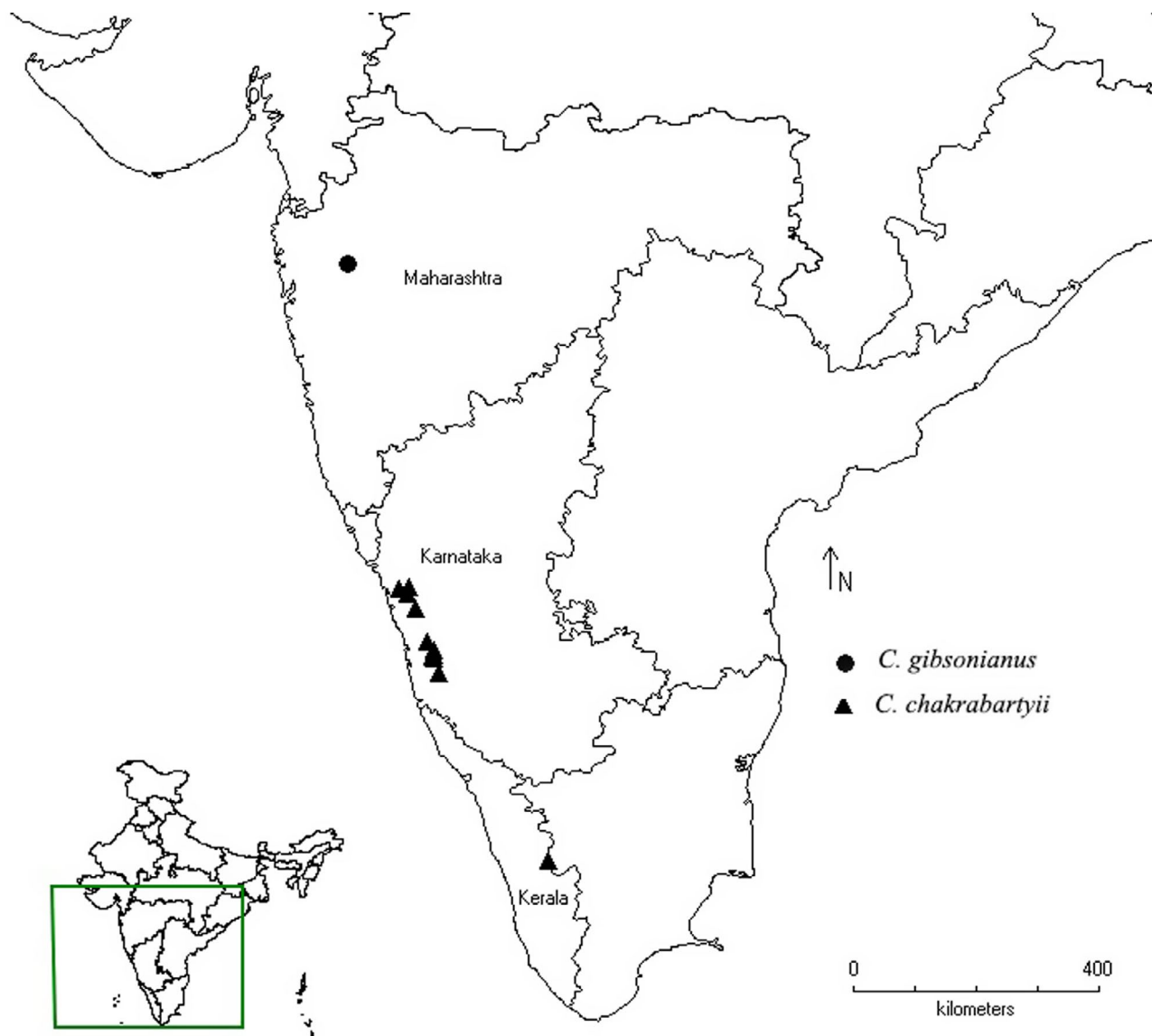


FIGURE 4 Distribution of *Croton gibsonianus* (a) and *C. chakrabartyi* (b) in peninsular India

Concern (LC) following IUCN Guideline version 14 (2019).

Illustration: *Op. cit.* Chakrabarty & Balakrishnan (1997)

Specimens examined (paratypes): India, Karnataka: Shivmoga, Agumbe, 03.01.1988, *M. R. Almeida* 3681 (BLAT!); Gersoppa falls, 10.1919, *Sedgwick & Bell* 7129 (BLAT!); *ibid.*, 10.1908, *Meebold* 9255 (CAL image!); *ibid.*, 27.11.1883, *Talbot* 827 (CAL image!); *ibid.*, 17.11.1884, *Talbot* 1095 (CAL image!); Hulikal Ghat, 24.08.1943, *R. S. Raghavan* 90181 (CAL image!); Tumakuru, Yedur (Yadiyur), 4.10.1962, *R. S. Raghavan* 82950 (CAL image!); Hosuru near Nedur, 5.10.1962, *R. S. Raghavan* 82994, (CAL image!); Uttara Kannada, Sampakhand, 10.1919, *Hall & McCann* 35140 (BLAT!); *ibid.*, Herb. *Sedgwick & Bell* 6989 (BLAT!, CAL image!); Chikkamagaluru, Gangamula, 10.03.1979, *S. R. Ramesh*

& *P. Prakash* KFP 6605 (JCB image!); Madikeri, Naravi, 29.10.1981, *C. R. Suresh* 342 (HIFP image!); precise locality unknown: Concan (Konkan), s.d., *Gibson* 20 (K barcode K000246847 image!).

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CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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